THE ESTATE OF ERIK A. POWELL, etc., et al. v. CITY AND COUNTY OF HONOLULU

U.S. District Court for the District of Hawaii
Civil No. CV04-00428 DAE-LEK

EXHIBIT "366"

Final Report
Powell et al. v. City & County of Honolulu
Civil No. CV04 00428 DAE-LEK

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10/5/06

This report consists of twelve pages.

My opinions in this case are based on the information contained in the numbered documents and other materials listed later in this report, upon observations as described, upon my professional knowledge and experience as a Professor of Oceanography specializing in ocean physics, and upon my knowledge and experience derived from more than 40 years of surfing and skindiving experience, including numerous visits to Hanauma Bay.

INCIDENT PARTICULARS

Type of Incident:	drownings
Date of Incident:	19 July 2002
Time of Incident (approximate):	~1120 – 1253 HST[1]
Location of Incident:	Hanauma Bay, Oahu, Hawaii

SITE

Hanauma Bay is located along the southeast Oahu coastline, with the axis of the bay facing southeast (Appendix A). Steep lava rock cliffs line the north and south sides of the Bay. There is a sandy beach along the head of the Bay, inside a broad, shallow fringing coral reef area, portions of which are exposed at lower tides. There are two channels

[1] For comparison purposes, this corresponds to 2140 hours on 19 July 2002 Universal Time (UTC) which is 10 hours ahead of Honolulu.

EXHIBIT 2

through the fringing reef. The Cable Channel is near the midpoint of the beach, while the Back Door Channel is close to the north side of the Bay. Water depths increase rapidly from the outer edge of the reef to the mouth of the Bay, where they are more than 100 feet deep.

WAVE CONDITIONS

The portion of the Bay seaward of the line between Palea Point and Witches Brew is directly exposed to wind waves generated by easterly to northeasterly trade winds, while only refracted trade wind swell or waves with a southerly component enter the region shoreward of this line. Waves entering the Bay break directly against the lava rock cliffs, or on the outer edge of the reef (e.g. video exhibit 15). During moderate to strong trade winds, the shorter wave components break against the south wall from Witches Brew out to Paioluolu Point, while some of the longer swell waves refract into the Bay and break on the reef. Due to the random nature of these waves and their interactions with waves reflected from the wall, the sea conditions in this area are very chaotic ("like a washing machine"). This is seen in video exhibit 14 from the day of the incident, and in video exhibit 15 from a later site visit. I have personally experienced these conditions in the area of Witches Brew. The extreme wave motion and the strong currents seaward of Witches Brew are hazardous to swimmers and snorkelers (cf. Scott, 1993, p. 55).

Wave buoy observations from various sites are archived at the Coastal Data Information Project (Scripps Institution of Oceanography, University of California at San Diego) web site (http://cdip.ucsd.edu). A wave-measuring buoy is maintained in approximately 100 m (325 ft) of water about 4 miles southeast of Mokapu Point, on the windward side of Oahu. This location is about 9 miles to the north of Hanauma Bay (see Appendix B). The statistics of the waves measured at the buoy location are also representative of the waves that occur over the same time interval in comparable depths outside of the mouth of Hanauma Bay. This buoy was operating prior to and during the time of the incident, providing directional wave spectra every half hour.

Bracketing the time of the incident, the significant wave height (H_S, the average of the highest 1/3 of the observed waves) was 1.84 m (6 feet), with a peak period Tp = 7 seconds (Appendix B). The direction of the peak waves was from 74°. These conditions are typical of moderate trade wind conditions affecting the region to the east-northeast of Hawaii.

WEATHER CONDITIONS

Easterly winds of 7-17 mph were blowing at the time of incident. Skies were partly cloudy.

TIDES

High tide occurred at Honolulu Harbor at 13:22 HST, with height about 2.11 feet above MLLW[2]. Tide levels at Hanauma Bay lead Honolulu Harbor by about one hour.

CURRENTS

The currents in the Bay have not been systematically measured, and the circulation within the Bay beyond the reef is not well known. Anecdotal evidence (e.g. Scott, 1993) suggests the presence of strong currents when the waves are higher than 1-2 feet. In particular, the Cable Channel is known to have very strong seaward flow under such conditions, as it is the primary return path for waters driven shoreward across the reef by breaking waves.

Whittle (2003) conducted drifter studies of the surface currents in the Bay during three days, 10 November 2000, 31 May 2001, and 1 December 2001. Measurements were made during incoming, outgoing and mixed tides. All days were during trade winds but with "calm" wave conditions. The measured currents were weak (averaging about 3 cm/s and maximum about 6 cm/s) and generally from the north side of the Bay towards the south side, with a shoreward component observed at times. Whittle (1993) concluded that the tidal currents do not seem to be a factor for circulation in the Bay, and without stronger winds and larger waves, the circulation is weak. Whittle (2003) also discussed undocumented current measurements made by P.F. Fan and J. Southworth during the 1960s, and concluded that strong (up to 50 cm/s) seaward flow is found close to the walls of the Bay.

Because wind and wave conditions are expected to be the dominant factors driving the circulation in Hanauma Bay, a study of the surface currents was made in part of the Bay while the wind and wave conditions were substantially similar to those occurring on the day of the incident. The methods used and the results obtained are provided in Appendix C. The overall conclusion is that in the vicinity of the Cable Channel, the strong seaward current in the channel weakens upon entering deeper water and turns toward the south, in part due to directly wave- and wind-driven shoreward flow. The surface flow, outside the reef and shoreward of a line between the Cable Channel and Witches Brew, was generally towards the south wall, either parallel to the reef or slightly towards shore. A convergence line (see Appendix A) with floating debris was seen about 5-10 m from the south wall, indicating a boundary with opposing flow on opposite sides. This is consistent with the suggestion by Whittle discussed above.

The location where Eric Powell was recovered at 1253 was identified in the HPD incident report (document 7) as "200 yards east of Witches Brew", which provides some information on the strength of the current seaward of Witches Brew on that day. [According to the City and County lifeguard reports (document 19), the first victim

[2] Mean Lower Low Water (MLLW) is the standard reference level for tidal heights.

(James Laughlin) was recovered from the water 1200 yards from tower 3A, while Mr. Powell was recovered 1300 yards from the tower. So the recovery location could have been only 100 yards east of Witches Brew, with the conclusion that the minimum current speed calculated below would be halved.] At 1120, one of the victims was spotted trying to climb onto the ledge at Witches Brew. If Mr. Powell was in the water close to that location and simply drifted with the current to the point of recovery, then the current was flowing eastward (seaward) at about 3 cm/s. The actual current may have been much stronger if Mr. Powell had been swimming against the flow for some portion of that time.

OPINION

According to the map in the police incident report (document 7), both victims were found floating in the water east of the ledge point in the Witches Brew area. During the time of the incident, currents were generally moving towards the south wall of the Bay, eventually bringing the victims into the strong and chaotic wave action in the area of Witches Brew. Close to the ledge, seaward-flowing currents would have carried the victims east of the ledge, which was even more chaotic, with multiple sources of wave reflection. These conditions would present a challenge even to an expert swimmer or a snorkeler in excellent condition. Breathing without inhaling seawater in such conditions would be difficult, whether using a snorkel or not. The victims were faced with fighting the wave and current forces, or attempting to exit the water along the wall while large waves were breaking against it. Successfully climbing out of the water onto the ledge would require good understanding of the wave dynamics, as well as prior experience and/or good luck. Some injury would be likely.

This report is based on the information that is available to date. It is my understanding that discovery is continuing in this matter, thus I reserve the right to further expand and/or amend my opinions and their bases if additional information relevant to my area of expertise becomes available.

DOCUMENTS AND OTHER CASE MATERIALS REVIEWED:

1) Map of Hanauma Bay State Underwater Park
2) Draft of Time Line
3) Sun and Moon Data for One Day – Friday 19 July 2002
4) Weather History for One Day – Friday 19 July 2002
5) Surf Observations and Forecast for Selected Oahu Beaches from the National Weather Service, Honolulu – Friday July 19, 2002 and Saturday July 20, 2002
6) Incident Report – Honolulu Fire Department
7) Incident Report No. 02-277-607 – Honolulu Police Department
8) Incident Report No. 02-277-608 – Honolulu Police Department
9) Autopsy Report – case No. 02-0953 – Erik Powell
10) Autopsy Report – case No. 02-0954 – James Laughlin
11) Interviews of Lifeguards Daniel Neves, Ron Bregman and William Goodwin
12) New articles : 7/6/02, 7/18/02, 7/20/02, 7/26/02, 8/17/02, 1/14/03, 5/27/03, 5/25/04
13) Videotape: KHON TV News Coverage Friday 19 July 2002
14) Videotape: Hanauma Bay, Law Offices of Ian L. Mattoch/SSJ, 10/9/03
15) Photographs: Hanauma Bay, Law Office of Ian L. Mattoch/SSJ, 10/9/03
16) Queen's Medical Center Records: Erik Powell, 7/19/02
17) Def. City & County of Honolulu's Response to Plaintiffs' First Request for Production of Documents
18) Def. City & County of Honolulu's Response to Plaintiffs' First Request for Answers to Interrogatories
19) Def. City & County of Honolulu's First Supplemental Response to Plaintiffs' First Request for Production of Documents
20) Def. City & County of Honolulu: Supplemental Production: Ocean Safety & Lifeguard Services Division Report
21) Deposition of Mary K. Powell
22) Deposition of Ron Bregman
23) Deposition of Clarence Moses
24) Deposition of Daniel Neves
25) Deposition of Robert Dorr
26) Deposition of William Goodwin

ADDITIONAL SOURCES OF INFORMATION

Mokapu wave buoy data from Coastal Data Information Project, Scripps Institution of Oceanography, UCSD [http://cdip.ucsd.edu]

Remote Sensing Systems, Inc. QuikSCAT Data Browse

Weather records from Marine Corps Base Hawaii (Kaneohe) via http://www.wunderground.com/US/HI/Honolulu/PHNG.html#History

REFERENCES USED

Scott, Susan, 1993: Exploring Hanauma Bay. University of Hawaii Press, Honolulu, 90 pp.

Whittle, Amber, 2003: Ecology, Abundance, Diversity, and Distribution of Larval Fishes and Schindleriidae (Teleostei Gobioidei) at Two Sites on Oahu, Hawaii. Ph.D. Dissertation, University of Hawaii, 100 pp.

PHOTOGRAPHS TAKEN BEFORE AND AFTER CURRENT STUDY

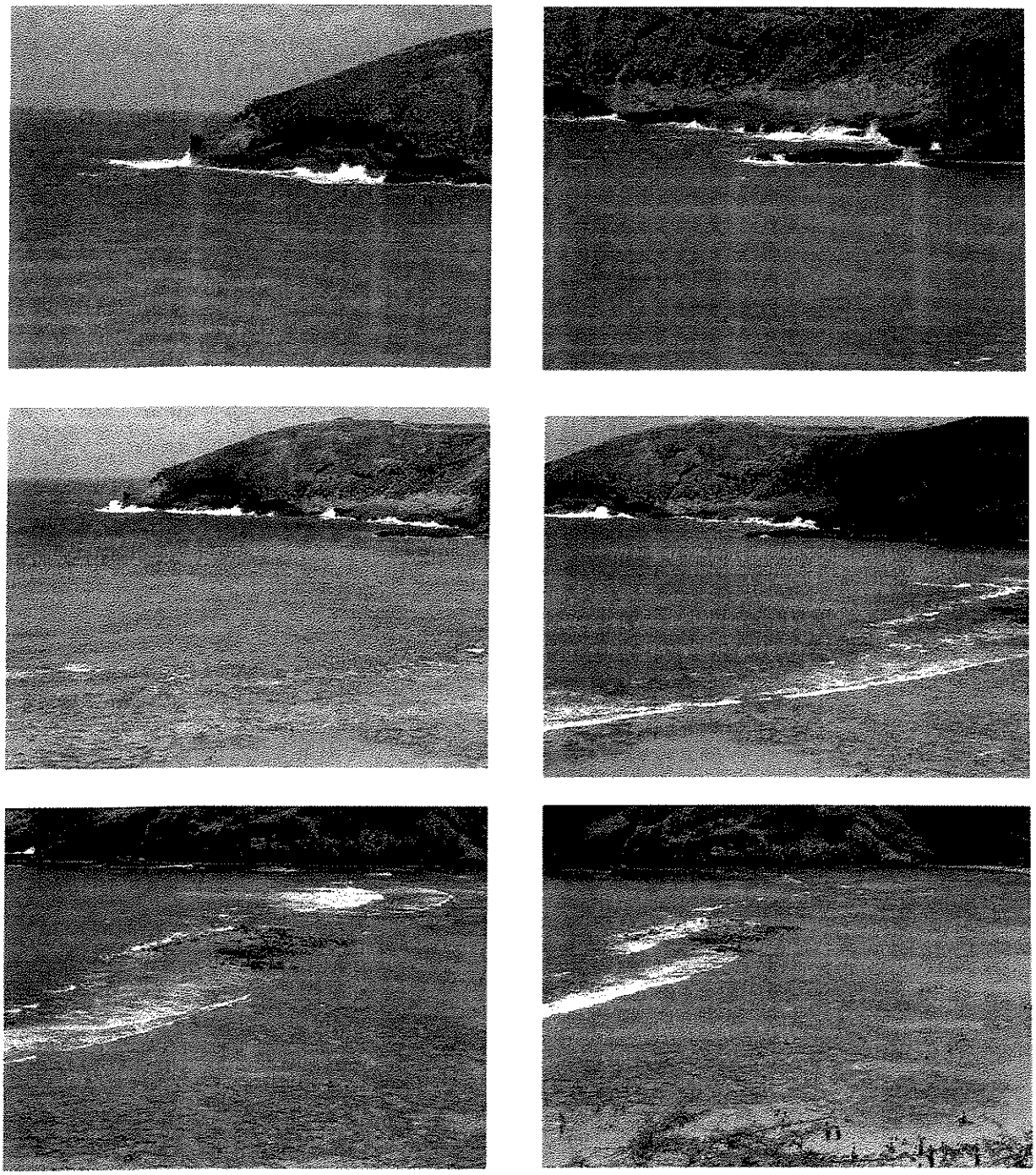


Figure 1(a-d). Photos of Hanauma Bay ~1245 HST on 15 June 2006.

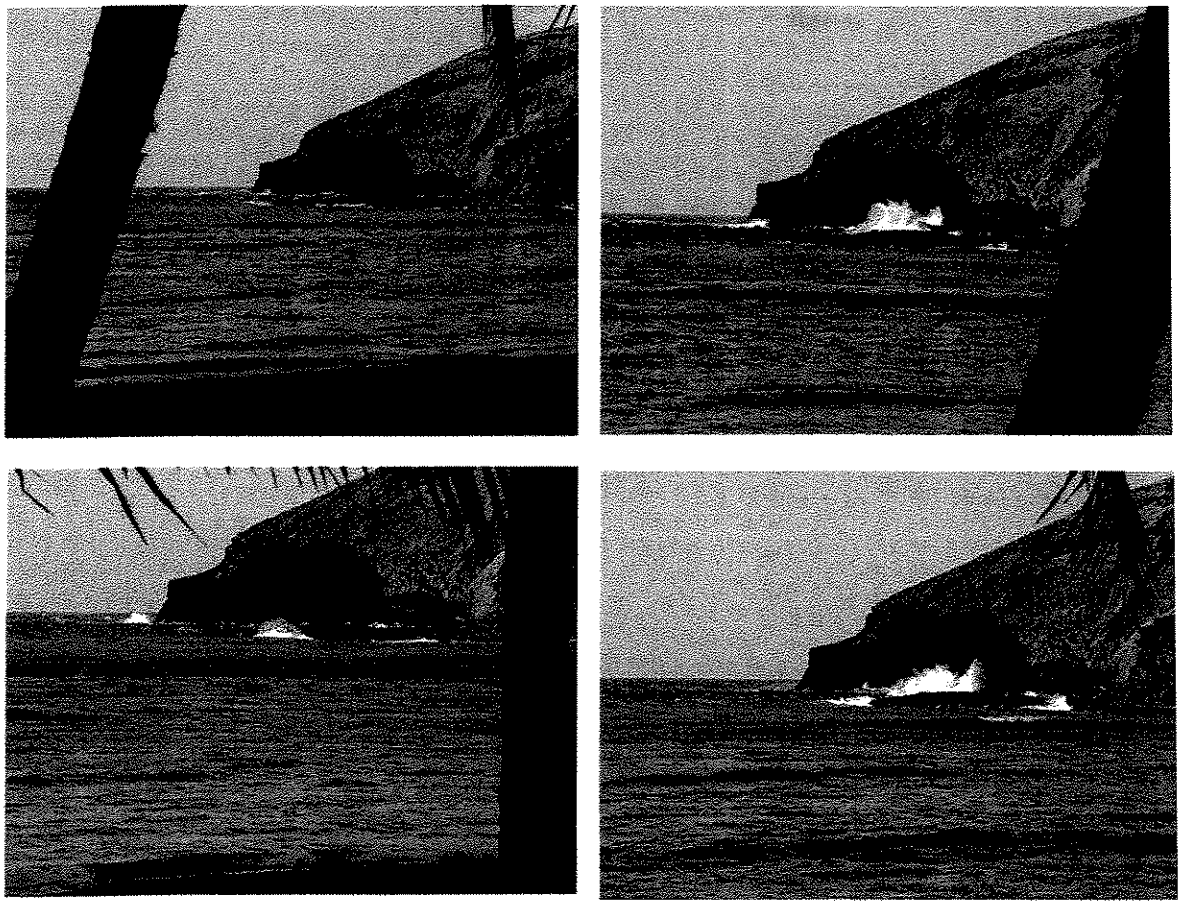
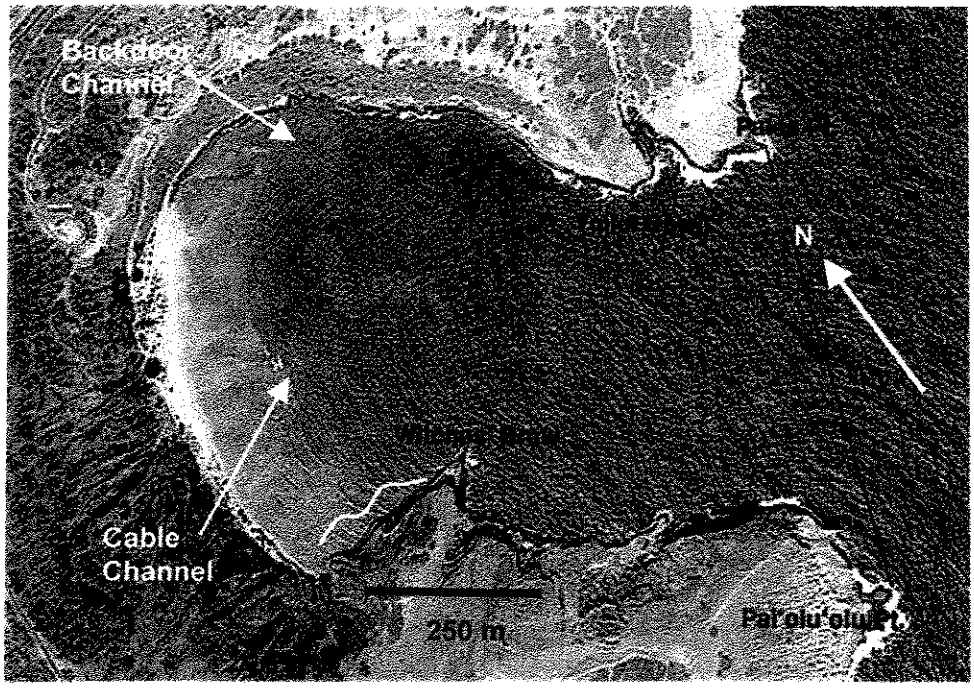


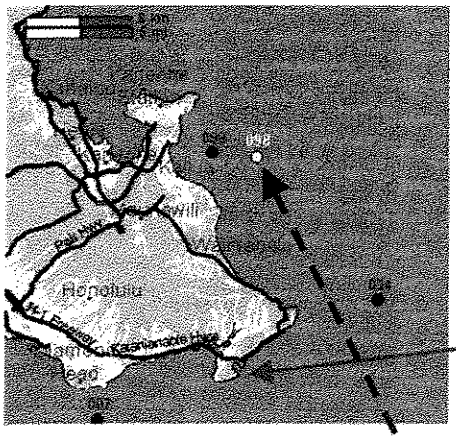
Figure 2(a-d). Photographs of Hanauma Bay ~1745 on 15 June 2006.

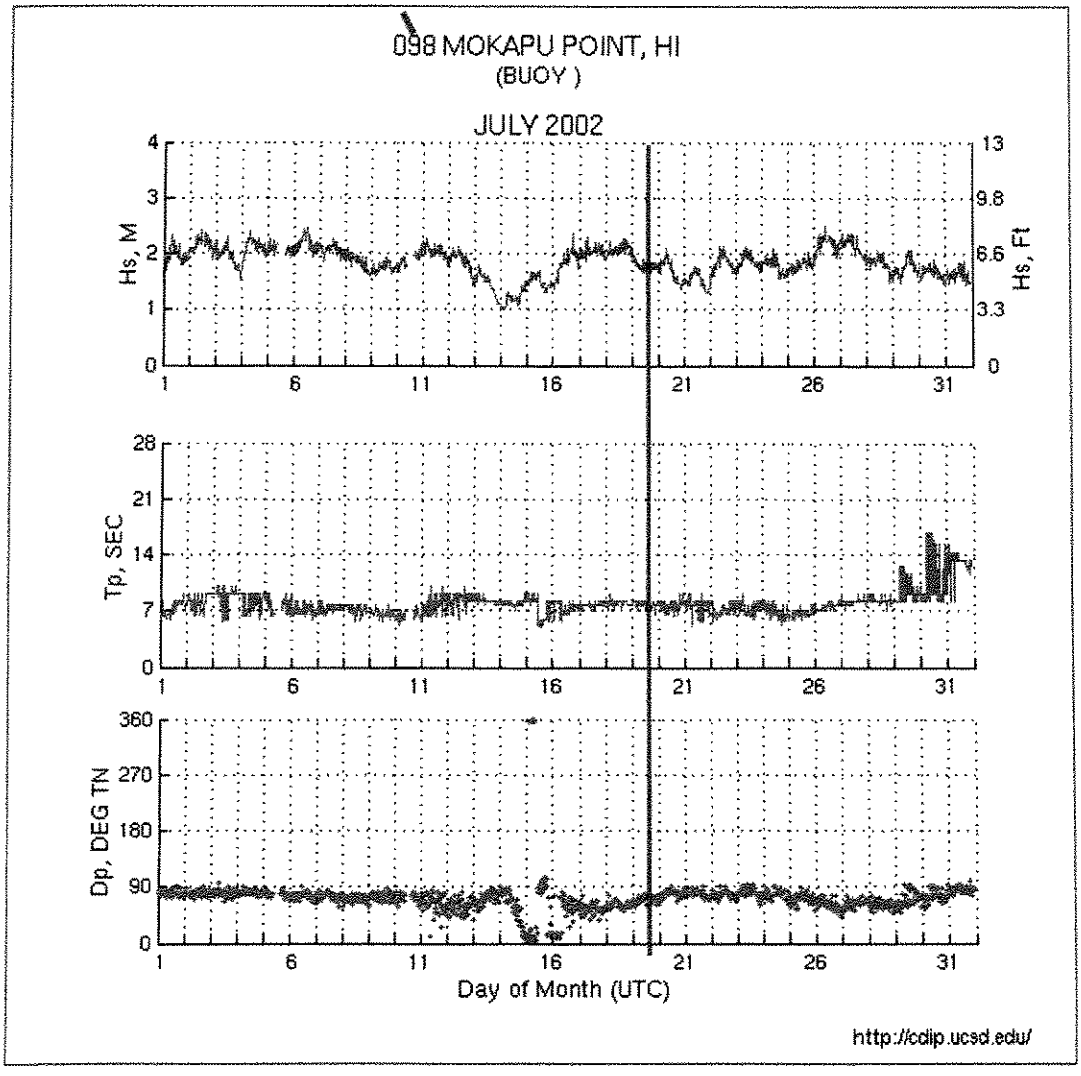
APPENDIX A: AERIAL PHOTOGRAPH OF HANAUMA BAY



Annotated aerial photograph of Hanauma Bay. The two channels through the reef separating the nearshore area from deep water are indicated. An approximate scale is provided by the red line. The jagged white line schematically indicates the location of the convergence line observed on the day of the current study (see Appendix C).

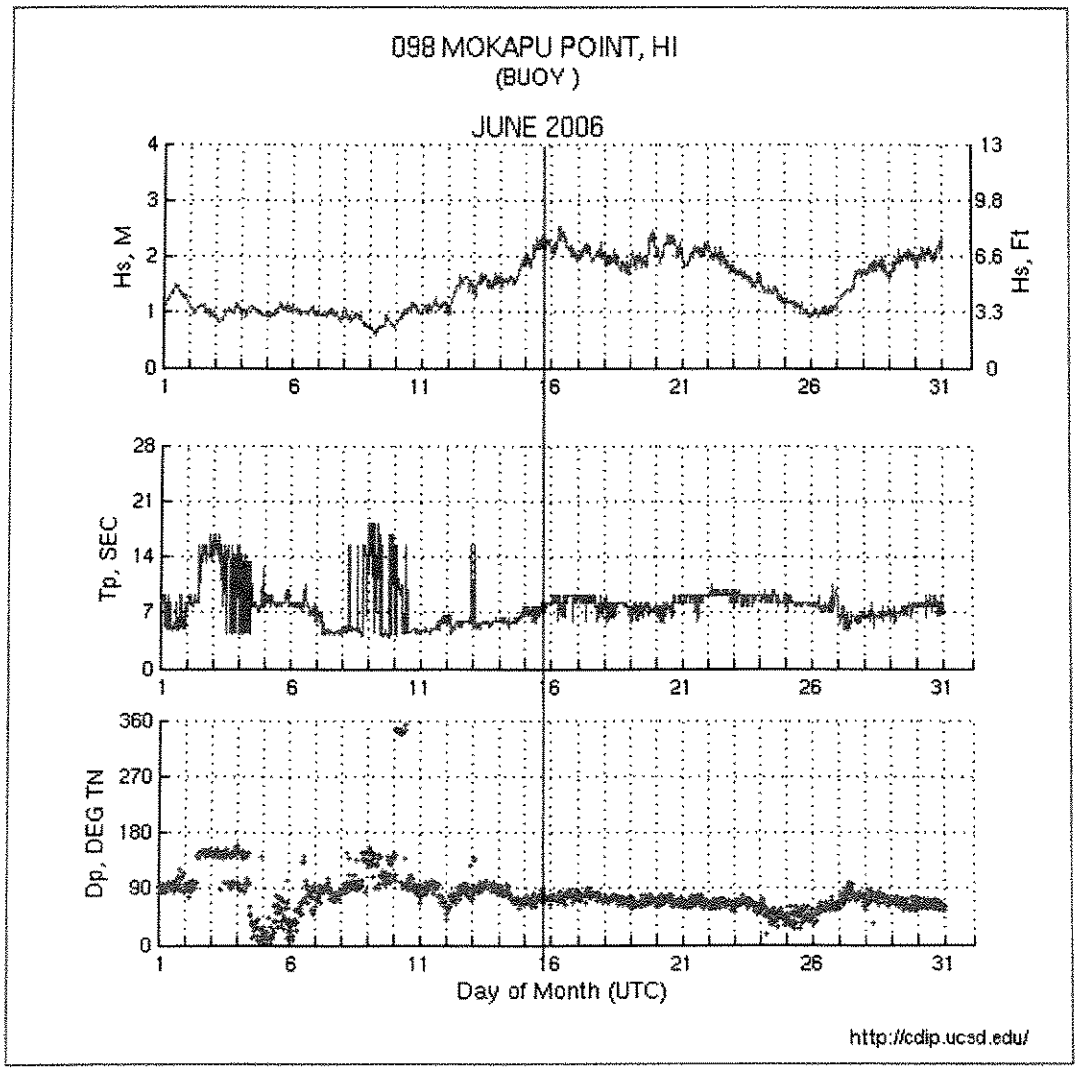
APPENDIX B: WAVE OBSERVATIONS AROUND TIME OF INCIDENT





APPENDIX C: HANAUMA BAY CURRENT STUDY

The current study at Hanauma Bay was conducted by R. Lukas and B. Baker on 15 June 2006, from about 1300 to 1800 HST. Winds were 10-23 mph from the east-northeast. The significant wave height at the Mokapu wave buoy was 2.1 m (6.8 ft) with the peak direction from 63-68°. The peak period was 7 seconds. The tide at Honolulu Harbor was rising, from a low tide of 0.02 feet at 11:44 HST to a high of 2.21 feet at 19:28 HST.



Drift measurements were made with a Magellan eXplorist 600 handheld Global Positioning System (GPS) device secured to a flat slab of Styrofoam. To ensure that the wind blowing on the float did not prevent the float from moving with the surface water, a weighted plastic bucket was suspended between 1 and 2 feet below the float with a line. The foam block extended about 2 inches above the water surface. At two points during the study, we verified that the float was moving with the surface waters by floating

vertically in the water next to the device for about 10 minutes. The device did not separate from the floating person.

Several surface drift measurement series were made throughout the afternoon, with a number of different starting locations bounded by the outer edge of the reef, the south wall of the bay, and a line between the Cable Channel and Witches Brew.

The Cable Channel current was not measured, but after transiting it four times, I estimate that it was flowing seaward at between 50-75 cm/s. This current appears to dissipate rapidly after entering deeper water. Outside the reef, the flow is dominated by a southward and shoreward flow. Current speeds ranged from 3-30 cm/s, but were generally about 10 cm/s.

A line of floating debris was observed near the south wall of the Bay, shoreward of the point at Witches Brew (see Appendix A). This was evidence of a convergence zone, where opposing currents exist on either side.

Making measurements near the ledge at Witches Brew was difficult, as the choppy waters made it difficult to sit on our surfboards. Measurements were terminated when the float appeared to be in danger of getting too close to the waves breaking on the wall.